Mound Laboratory

MIAMISBURG, OHIO

operated by

Monsanto Chemical Company

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MOUND LABORATORY
Operated By
MONSANTO CHEMICAL COMPANY
MIAMISBURG, OHIO

A LARGE DIAMETER VACUUM VALVE

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INTRODUCTION

During the preliminary operation of a volatilization apparatus it became apparent that a large stopcock in the high vacuum side of the oil diffusion pump was quite unsatisfactory Since it was necessary to mount the stopcock in a relatively inaccessible location the difficulty of turning the plug and the consequent necessity of regreasing the valve approximately every week were real problems Also it became apparent that an increased pumping speed through the valve would be required. Since a larger stopcock was out of the question, a type of valve reported by Stern[1] was modified in design and was built into the apparatus

DETAILED REPORT

This valve shown in Figure 1, makes use of an "O" ring seal between a glass tube and a brass plunger The plunger is moved by means of a steel shaft which passes through two "O" ring seals in a brass ball joint to a handle outside the vacuum system The brass ball joint is ground to fit a standard ground-glass socket

Pyrex tubing 30 millimeters inside diameter was used for the valve This size was chosen to conform to sizes in the rest of the vacuum system A straight tube free of internal imperfections and having minimum variation of inside diameter was hand picked from glass stocks Several neoprene "O" rings were tried and the size 1 inch by 1 1/4 inch by 1/8 inch was chosen as the best fit for the tube

The glass work was completed first and the metal parts then designed to fit the glassware Drill rod stock 5/16 inch diameter was chosen for the shaft because of its uniform diameter and smoothly ground surface. Manufacturers recommendations for "O" ring compressions and seat sizes were followed as closely as possible

With the plunger located at "A" as shown in Figure 1, the valve seals the high-vacuum side of the diffusion pump. The vacuum system may then be opened to atmospheric pressure and any necessary operations performed while the diffusion pump is kept ready for pumping Pre-evacuation of the system by means of the fore-pump outlet was usually necessary before moving the plunger although it is possible to pull the valve against atmospheric pressure

Moving the plunger to "B" opens the system to the diffusion pump and closes the fore-pump outlet Leakage past the large "O" ring in this position is negligible because the pressure differential across the plunger is, at most several microns Consequently the vacuum attainable should be limited only by the tightness of the system and the volatility of the lubricating material. Silicone grease is recommended for lubrication[1] both because of its low volatility and because it is not absorbed appreciably by the neoprene "O" rings

The plunger travel is limited by the outside handle in position "A" and a brass collar on the shaft in position "B". A stop is necessary when the plunger is at "A" to maintain its position against atmospheric pressure. The collar stop for the upper position is merely for convenience. It was thought also that some sort of handle lock would be required to prevent air pressure on the shaft from moving the plunger out of position "B" but to date the friction of the "O" ring seals has been sufficient to prevent this

Several tests of the vacuum properties of the valve have been made A Pirani gauge was inserted temporarily between "A" and the diffusion pump to check the effectiveness of the plunger seal against air pressure. With the diffusion pump running and the upper part of

the valve open to air the gauge registered a pressure of less than one micron, this was ample protection for the diffusion pump. With the valve assembled into the vacuum system the pressure of the system could be maintained indefinitely at 5×10^{-7} millimeter of mercury by continuous pumping. There was good reason to believe that this pressure was the limit of the system and that the valve would hold still lower pressures.

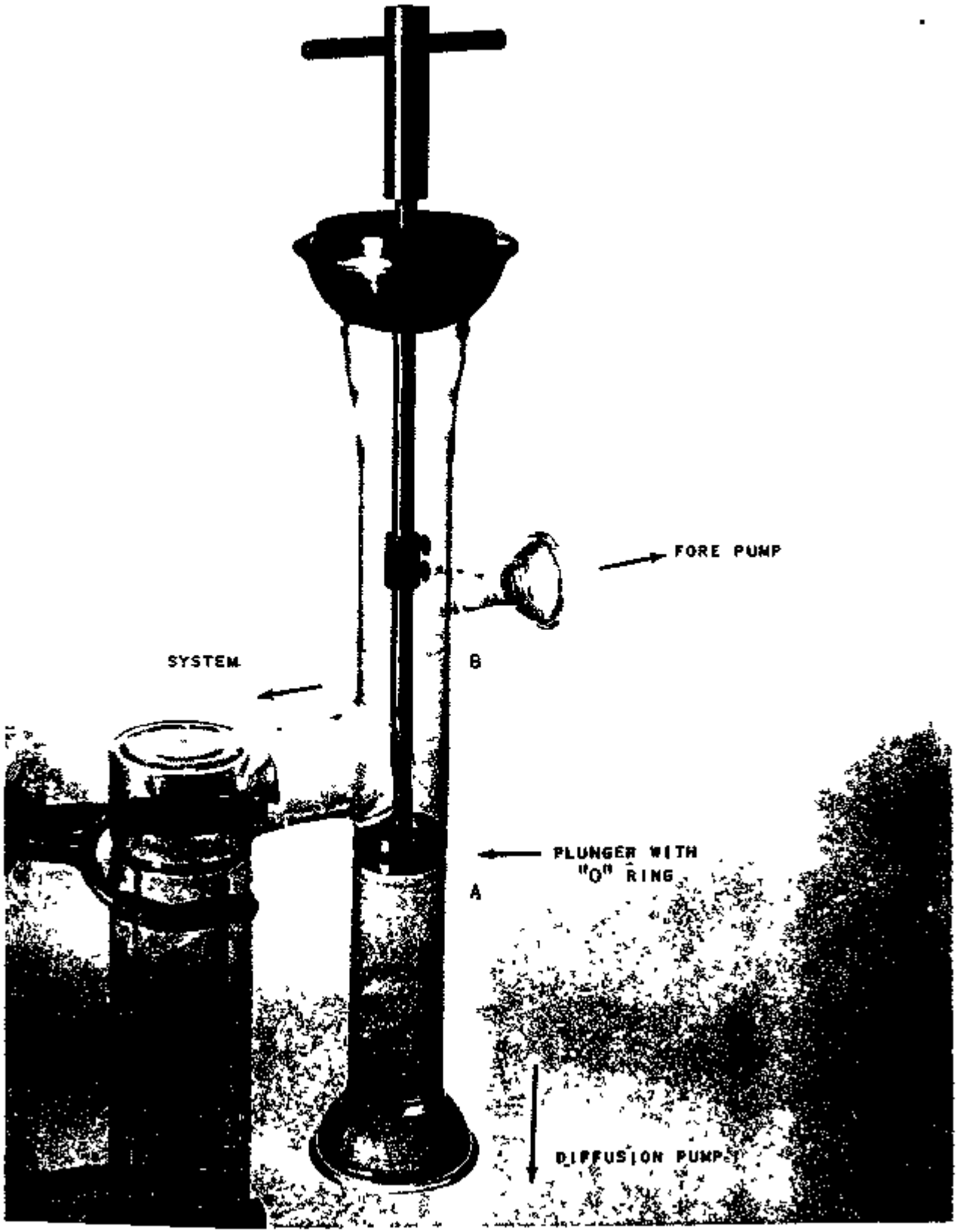
The pumping-down time for the outgassed system was checked. It was found to be possible to pump the system, approximately 1.3 liters in volume, from atmospheric pressure to less than 10^{-5} millimeter of mercury in 30 minutes. Two or three hours pumping pulled the system down to 5×10^{-7} millimeter of mercury.

There was apparently little, if any, leakage past the shaft seal. A small leak here, however is not serious as it can be compensated for by intermittent or continuous pumping by the fore pump.

Since this valve has lived up to its expectations very well, it is thought that an apparatus of this type may be of interest to other persons using glass vacuum systems at Mound Laboratory.

REFERENCE

1 Stern J Rev Sci Inst 22 703 (1951)



PLUNGER-TYPE VACUUM VALVE